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Heating element for cooking appliances

Specification

The present invention concerns a heating element for a cooking appliance, especially for direct and/or indirect heating of at least one cooking product, comprising at least one supporting layer and at least one heating element layer which contact the supporting layer at least in sections in a direct or indirect manner. Furthermore, the invention concerns a cooking appliance comprising at least one heating element according to the invention, as well as a method for the production of a heating element layer of a heating element according to the invention.

Heating elements for cooking appliances have been known to the person skilled in the art for a long time. These are generally electrical heating systems or cooking fields for cooking appliances with a non-metallic, for example ceramic, or metallic supporting plate and heating resistors applied onto it directly or indirectly. For example, DE 40 28 354 A1 discloses a heating element comprising a supporting plate made of ceramic material with several conducting resistor paths applied on this supporting plate which in turn can be supplied with current through control elements that are arranged on the back side. Bimetallic switches are proposed as control elements which, when a conducting contact is deviated sufficiently due to the heat, will create or interrupt the resistance or conducting paths. The connection of the bimetallic strips to the electric lines is conventionally done by soldering or screw-in contacts, so that failure of the heating element may occur due to material stresses in the region of the contact caused by heat load and/or temperature fluctuations.

DE 100 06 953 A1 concerns electric hotplates containing at least one heating element and a temperature sensor which is connected to a heat conducting element, which can be designed as an elastic element, and is pressed against the bottom side of the electric hotplate in the region of the temperature sensor. In this way, through a permanent contact with the hotplate, the temperature of it can be determined continuously and reliably. The contact to an electrical heating is produced through a heating conductor connecting part in the form of a plug contact attached to the outer peripheral wall of the electric hotplate. The heat conductor connecting part is thereby connected, on the one hand, in a conductive manner with heat conductor bands, and, on the other hand, with electrical supply lines of the electric hotplate

and thus themselves are exposed to extreme heat radiation. Therefore, here too, erroneous functioning of the electric hotplates may occur when the electric contact fails due to heat exposure and due to the material stresses related to that.

DE 694 05 958 T2 discloses a steam generator with an electrically heated plate, comprising a first fixed plate which is equipped with an electrical heating resistor and a ~~second mobile~~ plate~~, which is pressed against a first main surface of the first plate by elastic~~ devices. Here the electrical heating resistor is guided through the inside of the fixed first hotplate. Since the heating resistor is incorporated into the hotplate, it is no longer possible to control the electric hotplate through this heating resistor locally. Also, failure of a heating resistor leads to a total failure of the steam generator.

DE 36 20 203 A1 describes an electric heating element consisting of a heating part and a connecting part, which consist at least partly of different electrically conducting materials, as a result of which the flexibility is increased and the mounting is supposed to be facilitated. In this way the heating part can be connected to the connecting part via separable clamping or plug connections in order to make such temporary connection possible without the use of an elastic element. Here, too, failure of the heating element may occur due to a defect in the electrical energy supply.

Furthermore, from DE 197 01 640 A1 a contact heat transferring cooking system with an electric cooking plate with a cooking plate body is known. The cooking plate body is heated through a heating resistance applied on its bottom side in the form of spiral or radial conducting bands. By designed control of the individual conducting bands or short-circuiting of several conducting bands, multicircuit cooking plates are obtained consisting of several heating zones. In order to achieve different heat outputs in various regions of the electric hotplate body, the conducting bands in the individual heating zones are controlled separately from one another. This increases the expenditure for the circuits and makes the use of several sensors necessary in the various regions of the electric hotplate to control a uniform heating output. This makes the electric hotplate require very high maintenance.

Modern electric hotplates or heating areas are characterized by the fact that a number of locally-limited heating elements can be controlled in a designed manner. Again, individual heating elements may have one or several heating resistors. The smaller the particular heating element units or heating resistor units and the more densely they are provided, the higher the expenditure for the technology of the apparatus required to control or regulate each individual heating resistor separately, which leads to increased failure probability. Ideally, each individual heating resistor is connected through a separate electrical line to a control and regulating unit. The connection of the heating resistors to the

electrical lines usually occurs through soldered contacts. In any case, the production of these is labor-intensive and time-consuming and also very expensive with regard to materials and thus overall it is a cost-driving factor. In addition, these soldered connections are continuously exposed to very high temperatures and significant temperature fluctuations, and therefore usually rapid material fatigue especially in continuous operation must be accepted, especially in large kitchens or cafeterias. The requirements related to this often lead to a negative evaluation of the value of the cooking appliance used since repairs frequently can be performed only by experts and this is related to lost time as well as to repair costs which are not negligible. In addition, non-uniform pressing pressure of a heating element to a surface to be heated leads to a different heat input at different points of the surface and thus to defective cooking results.

Therefore, the task of the present invention was to develop the generic heating elements for a cooking appliance in such a way that it does not have the disadvantages of the state of the art and especially it provides electric hotplates with a high density of heating resistances which are very maintenance- and operator-friendly. Mainly, a heating element should be provided which makes it possible to have a very maintenance-friendly control and uniform and failure-safe introduction of heat into a carrier layer, especially into a pan of a cooking appliance. Furthermore, a cooking appliance as well as a method for production of a heating element layer of a heating element are to be provided which overcome the disadvantages of the state of the art.

Accordingly, a heating element was discovered for a cooking appliance, especially for direct or indirect electrical heating of at least one cooking product, with at least one electrical contact or conducting element and with at least one elastic arresting element which is or can be connected to the electrical contact or conductor element, whereby the electrical contact or conductor element can be brought into contact through the elastic force of the elastic arresting element at least intermittently, with at least one heating resistance and/or with at least one contact point of the heating element layer.

With the heating element according to the invention it is possible to connect hotplates, heating layers or heating resistors without any soldered contact to an electric conductor band reliably and permanently and thus almost free from maintenance. For this purpose generally it is only required that the conducting element be pressed through the elastic force of the arresting element, for example a spring, to the heating resistor or be clamped between the arresting element and the heating resistor. For example, the conductor element, in an expedient embodiment of the invention, can be designed to be rigid and in addition connected in a fixed manner to the elastic arresting element. In this case, the elastic force of the

arresting element is chosen appropriately in such a way that the conductor element is surely pressed on the heating resistor, but its shape is not thereby altered permanently.

Hereby, in another embodiment it can be provided that this heating element be a hotplate, especially an essentially planar hotplate or one with heating that is essentially tubular, either completely or section-wise, especially in a cylindrical form. Accordingly, the heating elements according to the invention are especially suitable for use in rotary evaporators, as they are described, for example, in WO 02/12790 as steam generators for cooking devices. The heating plates can be fundamentally planar, bent, wavy or have any other desirable form.

In a further expedient embodiment of the invention, at least one separating layer lies between the carrier layer and the heating element layer, preferably comprising at least one graphite layer for making the heat input into the carrier layer uniform at least in regions, and/or having at least one mechanical buffer layer and/or at least one first thermal insulation layer, preferably including a mica layer present at least in sections on the side of the heat element layer which is away from the carrier layer and/or between the heating element layer and the elastic arresting element. In one embodiment, the carrier layer can be designed as a carrier plate. Naturally, for example, the carrier layer, the heating element layer, the separating layer, the mechanical buffer layer, the first thermal insulation layer and/or the elastic arresting element can be adjusted to the selected form of the heating element or may assume it completely.

Hereby, according to an embodiment, it can be provided that the carrier layer consist completely or partially of stainless steel and/or the mechanical buffer layer consist completely or partially of mica.

According to a further aspect of the present invention, the heating element according to the invention comprises at least one pressing means, preferably comprising a pressing plate, with which the elastic arresting element preferably comprising an elastic element plate, the mechanical buffer layer, the first thermal insulation layer, the heating element layer and/or the separating layer, can be pressed against the carrier layer in order to make the pressing strength onto the carrying layer and/or the heat input into the carrier layer more uniform, at least in regions. The heating element present in this embodiment has essentially a pressed sandwich structure. Because of the use of a mechanical buffer layer, for example in the form of a mica layer or the first insulation layer, preferably in the form of a mica layer, both the arresting element as well as the heating element layer and/or the separating element layer or the graphite layer is protected against mechanical overstressing or damage even during strong thermal exposure. This pressed-together structure is also space-saving for

storage and transportation and can be incorporated into cooking appliances in a simple and reliable manner.

According to an especially preferred further development, it should be noted that the mechanical buffer layer, the first thermal insulation layer and/or the pressing means have at least one outlet for the contact and conductor element in the region of at least one second section of the elastic arresting element. Since the mechanical buffer layer, the first thermal insulation layer, and the pressing means, between which the elastic arresting element is present, forced in, at least in sections, have outlets, a second section of the arresting element has freedom of movement in the direction of the supporting layer and is removed from this. For example, if the arresting element is a metal plate, this is usually stress-free in the planar, flat state. By deflecting at least a first section of the arresting element from the stress-free resting position, generally a restoring force is built up. The resulting restoring force can be used in the present case for pressing the conducting element connected to the deflected section of the arresting element or a contact element against the heating element layer.

Hereby, according to the invention, it can be provided that the elastic arresting element have at least one first section, lying, on the one hand, between the heating element layer, the first thermal insulation layer and/or the mechanical buffer layer, and, on the other hand, the pressing means, and a second free section which is joining the first one and which can be connected or bonded directly or indirectly to the contact or conducting element, especially through a third section, whereby the second section preferably lies in the region of the outlet. Accordingly, the arresting element has at least one first section, which is clamped between the pressing means and the carrier layer, preferably the mica layer, and a second section, which can essentially be freely swiveled. Hereby the conducting element can be connected directly to this second section or it can be connected by inserting another, third section with the arresting element. In one embodiment, the arresting element ends with its free end, that is, the first or third section in the region of the conducting element.

In any case, according to a further embodiment, at least one fourth section can be provided which is joined to the second and/or third section of the elastic arresting element and/or to the contact or conducting element, whereby the fourth section is preferably bonded or can be bonded to the mechanical buffer layer, the first thermal insulation layer and/or to the pressing means. For example, the fourth section can be used to support the arresting element at the edge of the outlet, and which lies opposite the first section of this. In this way the room for movement of the arresting element is limited, but not to such an extent that it could prevent bonding with the aid of elastic force. Rather, with the aid of the fourth section, a very safe positioning of the arresting element can be achieved.

More preferably, the contact element or conducting element can be joined or bonded through an insulator, preferably in the form of an insulating sleeve, to the elastic arresting element. For example, this can be an insulating sleeve which is inserted on the one hand into the second or third section of the arresting element and on the other hand can hold the contact element so that it can be shifted.

~~Especially advantageous heating elements are characterized by the fact that the~~ heating element according to the invention, looking from the supporting layer in the direction of the elastic arresting element, has as supporting layer or as heating element layer at least in sections at least one stainless steel layer and at least in sections at least one ceramic layer as well as furthermore at least in sections at least one layer with electrical heating resistors and/or at least in sections at least one glass layer. Naturally, the glass layer is not continuous at the positions at which the conducting element comes into contact with the heating resistor.

According to an alternative embodiment, a supporting layer according to the invention is used, which, looking at it from the free outside surface of it, has at least one layer containing at least one heat conducting metal, especially steel, at least one layer containing at least one metal with good thermal conductivity, especially copper, and at least one second insulating layer.

Furthermore, alternatively, it can be provided that the supporting layer, looking at it from the free outside surface, has at least one layer containing at least one metal with good thermal conductivity, especially copper, at least one layer containing at least one metal with poor thermal conductivity, especially steel, and at least one second insulating layer.

Furthermore, those heating elements according to the invention are also suitable in which the carrier layer, looking at it from the free outside surface, has at least one electrically insulating ceramic layer, at least one electrically conducting ceramic layer and/or at least one second insulating layer.

Hereby it can be provided that the heating element layer is designed as a thick layer or as a thin layer.

Hereby it can be provided that the heating element layer can be produced by serigraphy or by a printing process, for example as a thick layer.

Furthermore, the task on which the invention is based is solved in another embodiment by a heating element in which the heating element layer has a multiple number of individual heating resistors, which are arranged in at least two heating tracks in such a way

that the heating resistors within each heating track are switched electrically parallel to one another, and the heating tracks are connected to one another electrically in series and that all heating resistors can be supplied simultaneously with electrical energy, whereby at least two heating resistors have different heating powers and/or the heating resistors are arranged on the heating element layer at different distances to one another, at least in regions.

~~The invention can also be characterized by the fact that the heating resistors are~~ provided through a thick layer.

Furthermore, it can be hereby provided that the heating resistors on the heating element layer can be produced with serigraphy or a printing process.

Furthermore, it is proposed with the invention that at least two heating resistors have different electrical resistors with different heating powers, especially different geometrical dimensions and/or are made of different materials, especially materials with different dopings.

Hereby it is preferably provided that the at least two heating resistors with different surface sizes have different peripheral shapes, especially at least one heating resistor has an essentially polygonal shape, especially trapezoidal, triangular, square, rectangular and/or hexagonal peripheral shape, different peripheral lengths, different side lengths, especially different widths and/or lengths, and/or different thicknesses.

Another further preferred embodiment of the invention provides that the heating power and/or the distance of the heating resistors, at least in regions but preferably over the entire heating element, be adjusted to a pressing strength of the heating element layer on the supporting layer, at least in regions, especially as a function of a local thermal conductivity of the supporting layer, at least in regions, predetermined heating power density distribution within the heating element layer and/or to a predetermined heat density distribution within the supporting layer, at least in regions.

In addition, it is hereby provided that the heating power of a heating resistor which is arranged in a first region of the heating element layer with a first pressing strength of the heating element layer onto the supporting layer, is lower than the heating power of at least one second heating resistor, which is arranged in a second region with a second pressing strength that is smaller in comparison to the first pressing strength of the heating element layer to the supporting layer and/or the distance of the two heating resistors to one another is larger in the first region than the distance between two heating resistors to one another in the second region.

Furthermore, the invention provides that the first region be located near at least one preferably neighboring at least one attachment location or pressing location, preferably in the form of an opening for at least partial leadthrough or penetration of an attachment device for applying the heating element layer to the supporting layer, and/or the second region is located further removed in comparison to the first region from at least one, especially not bordering on at least one attachment location or pressing location.

Furthermore, it is preferred that the heating power of a third heating resistor which is arranged in a third region of the heating element layer with a first heating power density of the heating element layer be smaller than the heating power of at least one fourth heating resistor which is arranged in a fourth region with a second heating power density of the heating element layer, which is lower in comparison to the first heating power density, and/or the distance of the two third heating resistors in the third region is greater than the distance of the two fourth heating resistors in the fourth region.

Hereby it can also be provided that the third region of the heating element layer be located near at least one, preferably neighboring at least one, first region of the supporting layer with a first thermal conductivity and/or with a first heat density and that the fourth region of the heating element layer is located near at least one, preferably neighboring at least one, second region of the carrier layer with a second thermal conductivity which is smaller in comparison to the first thermal conductivity and/or with a heat density which is larger in comparison to the first heat density.

Furthermore, according to the invention it is proposed that the electrical heating resistors of a heating track have essentially the same heating power, essentially the same geometrical dimensions, essentially the same distance to one another and/or be made essentially of the same materials.

Especially it can be provided that the separating layer, the heating element layer, the mechanical buffer layer, the first insulation layer, the elastic arresting element and/or the pressing means be designed as one element.

Especially, it can be preferred according to the invention that the pressing means, the elastic arresting element, the mechanical buffer layer, the first thermal insulation layer, the heating element layer and/or the separating layer bee joined to one another separably or solidly, especially with the aid of adhesion, preferably with the aid of an adhesive.

In one advantageous embodiment of the invention it is provided that each of the heating tracks have a multiple number of heating resistors arranged at least pairwise neighboring each other, whereby the heating resistors have a surface that is limited at least partially, preferably in a plane through first and second side edges, whereby two neighboring heating resistors, for the purpose of achieving electrical parallel connection, have first facing neighboring side edges, which are at least partially at a distance from one another, and/or ~~especially are electrically insulated through at least one insulating intermediate layer or~~ electrical insulation.

Hereby it is proposed according to the invention that two facing neighboring second side edges of the heating resistors of neighboring first and second heating tracks, for the purpose of achieving electrical series connection of the heating tracks at least partially, be connectable or be connected at least partially through at least one first electrically conducting means, especially in the form of at least one first electrical conductor track which lies especially at each second side edge of the heating resistors of the first heating track and two, especially each second, side edges of the heating resistors of the second heating track, whereby with the aid of the first electrically conducting means an electrical current can be conducted through the electrical heating resistors of neighboring first and second heating tracks.

Hereby it is preferred that at least one second electrically conducting means which joins at least two especially all second side edges of heating resistors of an outer heating track in a conducting manner, which are especially not neighboring a first or second side edge of a heating resistor, whereby the at least one second electrically conducting means has especially at least one contact point and/or is in working relationship with at least one contact point.

According to the invention it can also be provided that at least one third electrically conducting means has especially no insulating intermediate layer to at least one especially each first and/or second side edge of a heating resistor of at least one first external heating track which is especially not neighboring a first or second side edge of a heating resistor of a first or second heating track.

It is also proposed that the first, second and/or third electrically conducting means have at least one electrical material of high conductivity, especially silver or copper.

Furthermore, it can be provided that the neighboring heating tracks be arranged essentially parallel to one another and/or at least one heating track be arranged along a rectilinear curved or circular path.

It is especially preferred according to the invention that the heating tracks be provided with different dimensions.

Finally, it can be provided in the heating element according to the invention that each heating track have at least three, especially at least five, electrical heating resistors, and/or at least three, especially at least five, heating tracks, which are preferably electrically connectable through at least one first electrically conducting means and/or through at least two contact points, to a power source.

Furthermore, the invention provides a cooking appliance comprising at least one heating element according to the invention.

This cooking appliance can be especially characterized by the fact that at least one heating element, preferably all heating elements can be secured on the cooking appliance separably, especially through a screw connection.

It is also proposed with the invention that a control and/or regulating unit be provided which is in working relationship with at least one, especially with all, heating element(s) and/or with at least one, especially all, electrical heating resistor(s) and/or with at least one sensor.

Furthermore, it is proposed that, through the control and/or regulating unit the heating power of the heating element, preferably of the individual heating resistors and/or at least of two groups of heating resistors can be regulated and/or controlled, especially as a function of at least one characteristic quantity which can preferably be detected with the sensor, such as a temperature, a moisture content, a degree of browning of the cooking product, a weight of the cooking product, a size of the cooking product, a type of cooking product or similar.

Finally, the invention provides a method for the production of a heating element layer of a heating element according to the invention comprising the steps of

- providing a substrate and
- applying heating resistors and electrical conductors using a serigraphy technique.

Hereby it can be provided that subsequently at least one covering layer is applied at least in regions.

According to the invention it is preferred that the substrate be made of at least one electrically conducting material, preferably a metal, especially stainless steel, glass, ceramic

and/or a plastic, and/or before applying the heating resistors, at least one thermally- and/or electrically insulating layer be applied onto the substrate at least in regions.

Furthermore it can be provided that the thermally- and/or electrically insulating layer be made with at least one ceramic material and/or at least one glass.

Furthermore, it can be provided that the cover layer be made of an electrically insulating material and/or a material protecting against mechanical influences, preferably made of a glass and/or a protective varnish.

Finally, it is proposed with the invention that the heating power, the electrical resistor and/or the distance of the heating resistors from one another be adjusted by dimensioning the geometrical measurements of the heating resistors.

With the heating elements of the present invention, a durable reliable contact between an electrical inlet and a heating resistor can be created simply and this connection is not material-intensive or requiring much repair. Moreover, in case of damage the defect can be eliminated rapidly and professionally even by a layman. Furthermore it is possible to provide and separately control a very large density of individual resistor units in a cooking field.

The maintenance friendliness of the heating element according to the invention is increased even further in a claimed embodiment in that it makes it possible to omit separate control of the individual resistor units with a simultaneously high uniformity of the heat input. In this embodiment with the aid of different sizes and the number of heating resistors on a heating element, it becomes possible not only to reach high safety against failure but also to adjust the heating power of the different regions of a heating element layer in a designed manner. Thus, for example, uniform heat input into a supporting layer is possible in spite of different pressing strengths of a heating element layer on the supporting layer. For this purpose the heating powers of the individual heating resistors or the distance between the individual heating resistors is adapted to the special environmental conditions in the individual regions of the heating element layer or of the supporting layer, for example the pressing strength of the heating element layer onto the supporting layer, to the thermal conductivity of the heating layer in different regions, etc. Furthermore, the life of the heating element layer is significantly increased since the failure of an individual heating resistor is not harmful to the providing of uniform heat input into the supporting layer, due to the number of heating resistors and because this failure can be compensated by neighboring heating resistors. Especially this is supported by the arrangement of a separating layer between the heating element layer and the supporting layer, since this leads to making the heat input more uniform. Furthermore, flow of current through the heating element is not

prevented by the failure of one or several heating resistors. Thus, a desired cooking result can be achieved in spite of a failed heating resistor.

Further characteristics and advantages of the invention follow from the description given below, in which a practical example of the invention is explained in detail with the aid of a schematic drawing. The following are shown:

Figure 1: a partial section of a heating element according to the invention; and

Figure 2: a top view of a heating element layer of the heating element according to the invention according to Figure 1.

Figure 1 shows a heating element 1 according to the invention in a partial cross-section. According to a preferred embodiment, between a carrier layer or plate 2 and a pressing plate 4 the following are arranged, in this sequence: a separating layer in the form of a graphite film 6, a heating element layer 8, a mechanical buffer layer in the form of a mica layer 10 and an elastic element plate 12. The graphite film 6 is applied on the bottom side of carrier layer 2 in a manner known to the person skilled in the art, especially to make the heat input into the carrier layer uniform. The heating element or heating resistor layer 8 can be applied, for example, with the aid of the known silk-screening method in a desired pattern, for example, onto graphite film 6. For the purpose of mechanical protection of this resistance layer or heating element layer, it is covered by a mica plate 10 at least in the essential parts. On the side of the mica plate 10 away from the heating element layer 8, an elastic element 12 is arranged at least in sections. For example, this can be a metal plate which is equipped with elastic properties at least in regions. The layer sequence of graphite film 6, heating element layer 8, mica layer 10 and elastic plate 12 is held as tightly as possible on the bottom side of supporting layer 2 using pressing plate 4. This can be done, for example, with the aid of a screw-nut construction 14, especially in such a way that the screw or a continuation of the screw is rigidly connected to the bottom side of carrier layer 2 and with the aid of the nut 16 a pressing pressure is applied on the outside of pressing plate 4, preferably by inserting a planar washer 18. By suitable adjustment of the nut 16 optimum pressing pressure can be achieved without fear of damage to the layer structure. In the region of the elastic element 12, as well as in the mica layer 10, an outlet 22 as well as in pressing plate 4 an outlet 30 are provided so that a contact element 24 to which the elastic element 12 functioning as the elastic arresting unit is connected is always in conducting contact with the heating element layer 8. If the elastic element 12 is made of metal, it is appropriate to connect the electrical line or the electrical contact element 24 to the elastic element 12 not directly, but with intermediate switching of an insulating sleeve 20. The contact element 24 is preferably equipped rigidly with the heating element layer 8 in the region of its contact, preferably with a strength which is sufficient to withstand a restoring force by the elastic element 12 without bending, even

under thermal exposure. For example, copper rods were found to be suitable materials for these contact elements 24. The elastic element 12 is squeezed between the pressing plate 4 and the mica layer 10 at least through one section, essentially so that it cannot move. In the region of outlet 22 we then have the possibility to bend out at least one further section 28 of the elastic element 12 in a direction away from the bottom side of supporting layer 2. Due to the elastic nature of element 12, there is always a restoring force acting on the contact ~~element 24 arrested in the insulating sleeve 20. This is utilized to provide long-lasting and~~ reliable contact with the heating element layer 8. The outlets 22, 30 in mica layer 10 and in pressing plate 4 can be dimensioned differently in each case, but they can also have the same size. Preferably the outlet 30 of the pressing plate 4 is larger than the outlet 22 of mica plate 10. Fundamentally, however, a reverse dimensioning is also possible. Preferably, the elastic element 12 extends beyond the insulating sleeve 20, for example with a section 34, and it can be designed in such a way that it will be in the region of the top side of pressing plate 4, with which it will be constructed.. Since also in this section 34 of the elastic element 12, whose deviation away from the bottom side of carrier layer 2 is utilized in a designed manner in order to provide bonding of the contact element 24 onto heating layer element 8, an especially safe and reliable contact source to an electrical line which is at least partly a component of contact element 24 or to a power source is provided. Specifically, no soldered connection of the electrical line to the heating element 1 is needed, but rather it is possible to omit soldered connections completely or to place these into a region which is not exposed to any thermal or mechanical stress. The electrical contact element 24 which is present in an insulating sleeve 20, can also be replaced in case of damage without any problems. The same also applies to the entire elastic element 12 when the pressing plate 4 is held with the aid of a screw construction 14.

The heating element layer 8, the graphite film 6, the mica layer 10, the elastic plate 12 and the pressing plate 4 can also be separable or joined to one another rigidly to simplify mounting, for example, using a glue. Furthermore, also various functions of the layers can be achieved with a single component or a single layer, since essentially we are dealing with the function of a layer especially for making the heat input uniform (separation and/or graphite layer) or for making the pressing pressure uniform (pressing and/or elastic element plate). For example, the pressing plate 4, which serves for pressing the various layers, and the elastic plate 12, which is installed for providing elastic pressing of the electrical contact element 24, can be made in one piece. Also, the mica layer 10 can fulfill not only the task of a mechanical buffer layer but also the task of a heat insulating layer. Alternatively to that, especially bordering the heating element layer 8, an additional first thermal insulation layer can be provided, which is preferably a mica layer.

Furthermore, the pressing plate can be made elastic at least on the surface which is facing the heating element layer, so that the mica layer 10 can be omitted.

Figure 2 shows a heating element layer 8 in a top view. Accordingly, the heating element layer 8 has heating tracks 804, 804', 805, 805' which run essentially straight and parallel to one another, and these tracks are composed of a multiple number of electrical heating resistances 806, 807, 806', 807'. The electrical heating resistors 806, 806', 807, 807' have a rectangular or square surface shape and in the present case are within a heating track 804, 804', 805, 805', which in each case have the same surface area and shape. Within each heating track 804, 804', 805, 805', are neighboring electrical heating resistors 806, 807, 806', 807', always separated from one another by electrical insulation 812. The insulation 812 prevents direct contact of first side edges 810, namely the first side edges 810.1 and 810.2 and 810.1' and 810.2', respectively, of neighboring heating resistors in the heating track. In contrast to the first side edges 810.1 and 810.2 and 810.1' and 810.2', the second side edges 820 of neighboring heating resistors of a heating track are not assigned to one another or are neighboring over longer sections. Neighboring heating tracks, for example 804, 804' and 805, 805' are not in direct contact with one another, but rather are joined together through first electrical conducting paths 808. Hereby, the second side edges 820 of electrical heating resistors 806, 807, 806', 807' of a heating track 804, 804', 805, 805' lie regularly against a first electrical conducting path 808. Similarly, the second side edges 820 of heating resistors 806, 807 of the always outer heating tracks 804, 805 of the heating element layer 8 forming the outsides 817 and 819 are connected to a second electrical conducting path 814 and 816. In this embodiment of a heating element layer according to the invention, electrical current cannot be conducted directly through neighboring electrical heating resistors 806, 807, 806', 807' within a heating track 804, 804', 805, 805'. Rather the electrical current is conducted through an electrical heating resistor 806 of a first heating track 804 by means of a first electrical conducting path 808 to the electrical heating resistor 806' of a neighboring heating track 804'. For example, a possible pathway for the electrical current is shown in the depiction of heating element layer 8 in Figure 2 and is designated with A. For example, if an electrical heating resistor 806 within a heating track 804 would fail during operation, the large number of heating resistors and the related relatively low surface area of the heating resistors connected to it leads to the fact that the entire heating plate can be used further without any problem. Especially, the failure of individual heating resistors 806, 807, 806', 807' can be compensated simply by the other electrical heating resistors 806, 807, 806', 807' of heating tracks 804, 804', 805, 805', so that orderly operation of the cooking appliance can be maintained. In this way it is possible to react very flexibly to the failure of individual electrical heating resistors. The desired cooking result is thus achieved even in the case of a partially damaged or not completely functional heating element layer 8. Thus, overall, the

cooking appliance will have a heating plate with a significantly longer effective life and thus lower maintenance requirements.

In addition, it can easily be seen from Figure 2 that the individual heating resistors in the different heating tracks occupy different surface areas. Thus, the individual heating resistors also have different electrical resistances and thus different heat outputs. The different sizes of the heating resistors 806, 807, 806', 807' are supposed to achieve especially equalization of the different heat transfer from the heating element layer 8 to the medium to be heated, especially to the supporting layer 2, see Figure 1, which, for example, can occur due to a different pressing strength of the heating element layer 8 onto supporting layer 2 in different regions of the heating element layer 8 of the heating element 1 according to the invention. For example, the surface of the heating resistors in the regions around the first openings 822, 824, 826, 828, which represent the recesses for the screw connection 14, are larger in order to compensate for the improved thermal conductivity in the heat carrier layer 2 due to the larger pressing strength. Due to the larger surface of the heating resistors and thus to their lower electrical resistances in this region, the heating power will be lower. Thus, the heating element layer 8 is designed so that the surface of the heating resistors is the largest in the areas with the largest pressing pressure, that is, the lowest heating power will be provided by the heating resistors, and will become smaller the farther the heating resistor is removed from the first openings 822, 824, 826, 828. The heating power of these heating resistors which are farthest removed from the first openings 822, 824, 826, 828 is in fact larger due to the higher electrical resistance. Thus it is achieved that the heating element layer 8 makes it possible to have a very uniform heat input over the surface into the supporting layer 2 and thus, for example, into a cooking container. The electrical contact elements 24 shown in Figure 1 are most preferably located at the contact points 830 and 830' shown in Figure 2, which are always connected to a second electrical conducting path 814, 816 onto which heating element layer 8 is pressed. A second opening 832 is located in the middle of heating element layer 8, which is provided for a heat sensor (not shown) and has essentially no influence on the pressing pressure. As a result of this design, monitoring of the heating power of heating element 1 is possible.

Thus, a multiple number of heating elements 1 according to the invention, which always have a heating element layer 8, can be introduced separably into a cooking appliance, whereby the heating elements 1 or their heating element layers 8 can have different sizes which are then introduced as a mosaic. Such a heating element layer 8 can be produced in the method according to the invention using a serigraphic technique or a printing technique, in a simple and uncomplicated manner. Hereby, a ceramic layer is applied onto a substrate, preferably in the form of a stainless steel plate, and onto that again heating resistors are applied with the serigraphic technique which can have different sizes in the manner described

above and conducting paths can be printed onto it. Finally, a mechanical protection in the form of a glass layer can be applied. This leads to very simple manufacture and the resistors can be designed arbitrarily on a model form.

Cooking appliances for which the heating elements according to the invention can be used include especially pans, hot air cooking appliances, steam cooking appliances, ~~combination steamers for operation with hot air and steam, steam generators, heating devices~~ in the form of at least one cooking field and units for keeping food warm.

The characteristics of the invention disclosed in the above specification, the claims as well as in the drawings can be essential for realizing the invention in its different embodiments in any arbitrary combination.

Reference list

1	Heating element
2	Supporting layer
4	Pressing plate
6	Graphite film
8	Heating element layer
~~10~~	~~Mica layer~~
12	Elastic element plate
14	Screw construction
16	Nut
18	Plane washer
20	Insulating sleeve
22	Outlet
24	Contact element
26	Section of elastic element 12
28	Section of elastic element 12
30	Outlet in pressing plate 4
32	Outlet in mica plate 10
34	Section of elastic element 12
804, 804'	Heating track
805, 805'	Heating track
806, 806'	Electrical heating resistor
807, 807'	Electrical heating resistor
808	Electrical conducting path
810	First side edges
810.1, 810.2	Neighboring first side edges
810.1', 810.2'	Neighboring first side edges
812	Electrical insulation
814	Outer electrical conducting path
816	Outer electrical conducting path
817	Outside of an outer heating track 804
819	Outside of an outer heating track 805
820	Second side edges
820.1, 820.2	Neighboring second side edges
822, 824, 826, 828	Opening
830, 830'	Contact point
832	Opening